4.7 GEOLOGY

The analysis contained in this section is based on a site-specific geological report prepared by *ENGEO Inc.* for the proposed project (August 2006). The site specific geotechnical report was prepared utilizing available sources of existing geotechnical information for the project area. The existing conditions section includes a description of geologic conditions within the entire CVSP Area; however, the discussion of impacts and mitigation measures focuses on the CVSP Development Area where actual construction would occur. The geological report is Appendix I of this EIR.

Introduction

Various policies in the City's General Plan have been adopted for the purpose of avoiding or mitigating geologic impacts resulting from planned urban development within the City. All future development addressed by this EIR will be subject to the geologic policies listed in Chapter 4, *Goals and Policies*, of the City's General Plan, including the following:

- *Soils and Geologic Conditions Policy #1:* New development should be required to evaluate sites and mitigate for geologic hazards.
- Soils and Geologic Conditions Policy #2: Public improvements should not be located in geologic hazards areas.
- *Soils and Geologic Conditions Policy #6:* Development should adequately mitigate soils and geologic hazards.
- *Soils and Geologic Conditions Policy #8:* Development should not cause or be affected by geological hazards on adjoining properties.
- *Soils and Geologic Conditions Policy #9:* Residential development should incorporate adequate mitigation/remediation for soils contamination.
- *Earthquake Policy #1:* New buildings are required to be designed and constructed to resist stress produced by earthquakes.
- *Earthquake Policy #3:* Approval of development requires mitigation of seismic hazards.
- *Earthquake Policy #4*: Public facilities should not be located in areas where seismic activities can produce liquefaction.
- *Earthquake Policy #5:* New development should be required to evaluate and mitigate for seismic hazards.

4.7.1 Existing Geologic Conditions

4.7.1.1 *Regional Geology*

The City of San José is located in the Santa Clara Valley, a broad alluvial-covered plain lying between the Santa Cruz Mountains to the west and the Diablo Range to the east. The Valley and the entire San Francisco Bay region are within an area known as the Coast Range Geomorphic Province, an area where the geology is dominated by the deformation of the earth's surface due to the movement of the Pacific and North American tectonic plates. The San Andreas Fault system lies along the intersection of these two plates.

San José is part of the seismically-active coastal area of California. The area is classified as Seismic Zone 4, the most seismically-active in the United States. The region is subject to strong ground shaking resulting from earthquakes occurring along the San Andreas Fault system, which includes the Sargent and Calaveras fault zones. The most recent large earthquake to affect the area was the

1989 Loma Prieta Earthquake, which measured 6.9 on the Richter scale. The Calaveras fault is located approximately three miles to the northeast of the CVSP area, while the Sargent and San Andreas faults are located approximately six and nine miles to the southwest, respectively, as shown on Figure 4.7-1. The Working Group on California Earthquake Probabilities has estimated that there is a 62% probability of a large (i.e., Richter Magnitude 6.7) earthquake in the San Francisco Bay region in the next 30 years. Therefore, the probability of at least one moderate to strong earthquake occurring during the life span of the project is considered high.

4.7.1.2 *Geologic Conditions within the CVSP Area*

The CVSP Area is located within the Coyote Valley area of southern Santa Clara County. It is a broad, relatively flat valley with elevations ranging from approximately 240 feet above mean sea level in the northwestern portion to about 360 feet above mean sea level in the southern portion of the CVSP Area. The Santa Cruz Mountains, along the western boundary of the CVSP Area, reach between approximately 800 to 900 feet above mean sea level. The nearest ridge of the Mt. Hamilton range, along the eastern boundary of the CVSP Area, reaches between approximately 1,200 to 1,400 feet above mean sea level. Mt. Hamilton itself, to the northeast of the CVSP Area, is approximately 4,200 feet above mean sea level.

The Coyote Valley is underlain by basin deposits and alluvial deposits ranging from Pliocene to Holocene age (about five million years old to recent time). Sedimentary deposits vary from about 200 feet thick at the northwestern end of the CVSP area to more than 400 feet thick in the southeastern end of the study area. Bedrock around the perimeter of the CVSP Area is predominantly Franciscan Mélange and serpentinite, roughly 70 to 150 million years old. Geologic units within the CVSP area include fills, colluvium, basin and alluvial deposits, gravels, and bedrock. For a more detailed discussion, please refer to Appendix I.

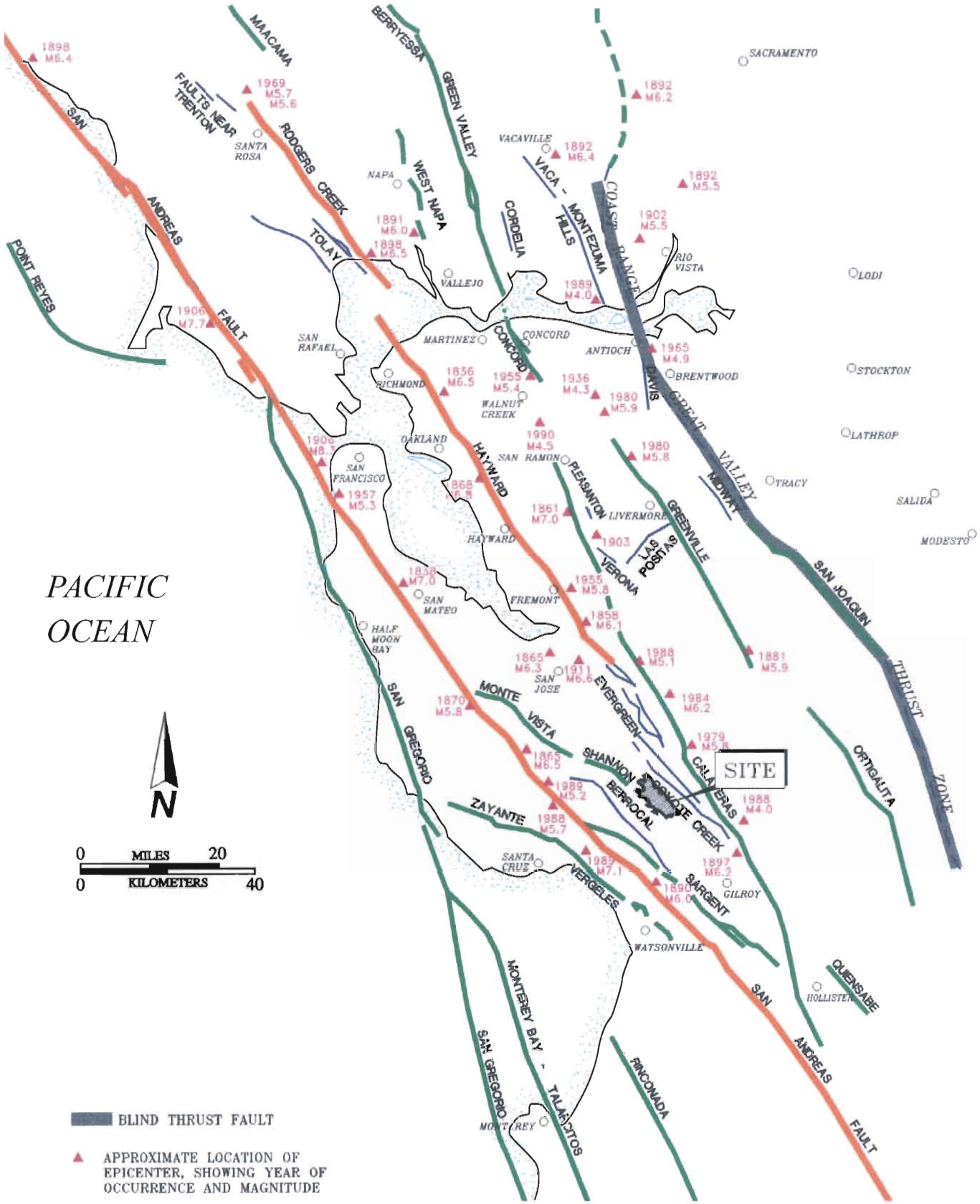
Landslides

Suspected landslide areas are shown on Figure 4.7-2 and appear to primarily involve soils but may include some highly weathered bedrock material.[36] Most of the mapped landslides are located in the northern portions of the CVSP Area, adjacent to the hillsides and are considered dormant based on subdued topographic expression and vegetated scarps. Some areas of more recent landsliding were observed in the northwestern portion of the CVSP area that have bare, near-vertical scarps and obvious slide deposits.

Expansive Soils

Moderately to highly expansive soils are expected within the upper few feet of the majority of the valley floor (Qhb, Qhf2) and within mapped swales (Qc) and landslides (Qls) located on the hillside terrain, within the CVSP Area (refer to Figure 4.7-2). Expansive soils shrink and swell as a result of moisture changes. This can cause heaving and cracking of slabs-on-grade, pavements, and structures on shallow foundations. Successful construction on expansive soils requires special attention during grading and foundation design.

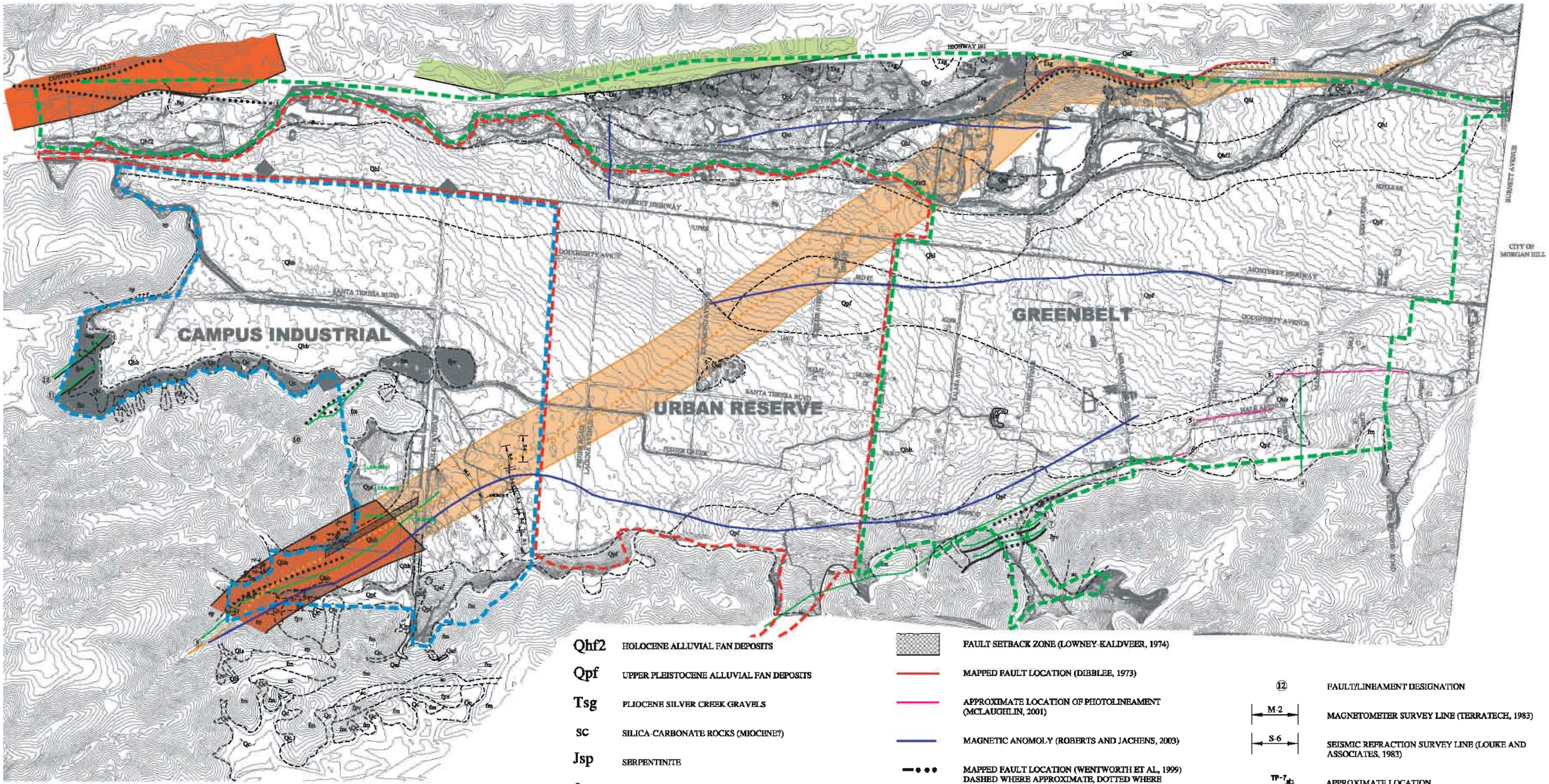
[36] This figure is a reduction of Figure 3 in the Geotechnical Report (Appendix H), which was originally printed at a large scale due to the amount of detail shown. The enlarged Figure 3 is on file at the City of San José's Department of Planning, Building, and Code Enforcement and can be viewed during normal business hours.



Source: Engeo, Inc./USGS Open File 96-706

REGIONAL FAULT MAP

FIGURE 4.7-1



LEGEND

Qaf	EXISTING FILL
Qls	LANDSLIDE DEBRIS
Qc	COLLUVIUM
Qhb	HOLOCENE BASIN DEPOSITS

Scale: 1" = ± 2,200'

GEOLOGIC CONDITIONS MAP

FIGURE 4.7-2

Chrysotile Asbestos

Serpentinite bedrock within the CVSP Area is the source for the basin and alluvial deposits within the project area. Some serpentinite bedrock contains the mineral chrysotile, a naturally occurring form of asbestos. When chrysotile asbestos does occur, it is typically present in concentrations of less than one percent but may be present in concentrations up to about 10 percent. The chrysotile mineral can become airborne when the serpentine rock is crushed or pulverized. Chrysotile asbestos is only considered to be a health risk when it is in this airborne form.

4.7.1.3 *Seismicity and Seismic Hazards Conditions within the CVSP Area*

The CVSP Area is not located within a State of California Earthquake Hazard Zone for active faults; however, portions of the area are located within City of San José Special Studies Zones and the City of San José Potential Hazard Zones for the Shannon fault and a fault associated with the Coyote Creek fault (refer to Figure 4.7-2). The portion of the Coyote fault within the CVSP Area has been determined to be potentially active and a portion of the fault is located within the City of San José Potential Hazard Zone. It should be noted that this fault is located in the northeastern portion of the CVSP Area where urban development is not proposed as part of the project.

The Cooper Clark map[37], upon which the City's General Plan is based, shows a concealed and queried trace of the Shannon fault across the central portion of the CVSP Area (Figure 4.7-2). While site mapping and aerial photograph interpretation shows that the fault follows a relatively prominent linear valley trending to the northwest of the area, no geomorphic features were observed during site reconnaissance and field mapping. Existing information regarding the fault (as described in Appendix I) was examined; however, definitive information regarding the location and status of the Shannon Fault was not found. A relief aeromagnetic map of the Santa Clara Valley prepared by Roberts and Jachen (2003) shows a magnetic lineation that extends south of Bailey Road, but then bends to the southwest, becoming roughly parallel with the western boundary of the CVSP Area. This mapping of magnetic data suggests that the Shannon Fault may not follow the postulated projection that was mapped by Cooper-Clark.

One study prepared in 1974 (Lowney-Kaldveer Associates) included exploratory trenching in the general vicinity of the IBM property, north of Bailey Avenue (maps were not available for review). Based on the findings of this study, which are described in detail in Appendix I, a development setback zone of at least 50 feet was recommended on the IBM property, as shown on Figure 4.7-2.[38]

To further address and characterize the activity of the Shannon fault, *ENGEO Inc.* excavated six exploratory trenches and a series of test pits in November and December 2005, to evaluate soils in the northwestern portion of the CVSP area, north of the IBM research facility at the location where the Shannon fault has been projected to enter the valley. Trenching locations can be seen on Figure 4.7-2.

The test pit depths ranged from five to 10 feet below the existing ground surface with some localized excavations to deeper depths to evaluate the soils or to follow stratigraphic units. Trench walls were observed for age-dating and soil samples were collected for carbon dating. Shear features encountered in the trenches appeared to be associated with older tectonic deformations of the Franciscan rock or the result of soil creep.

[37] *Geotechnical Investigation of San José*, Cooper-Clark, 1974.
[38] Lowney-Kaldveer Associates, 1974.

Based on the findings of the fault exploration, no indications of Holocene-age faulting or seismic ground deformation were observed within the study area. No indications of faulting were encountered in the IBM area where the setback zone had been previously recommended as a result of the 1974 study. Shears were generally observed to be discontinuous, undulating, and in orientations that are not consistent with the mapped trend of the Shannon fault. In addition, while a few scattered seismic events have been recorded in the valley ranging from 1.5 to 2.0 Magnitude; no seismic events have been recorded along the Shannon fault within the Coyote Valley. The faults and lineaments previously mapped in the study area do not appear to be active and the potential for ground rupture along these faults is considered unlikely.

Earthquake Induced Liquefaction, Lateral Spreading, and Landsliding

Liquefaction is a condition where saturated granular soils near the ground surface undergo a substantial loss of strength during seismic events. Loose, water-saturated soils are transformed from a solid to a liquid state during ground shaking, which can result in significant deformations. The potential for liquefaction within the CVSP Area ranges from low to very high, consistent with the region, as shown on Figure 4.7-3. The Coyote Valley area, as well as the majority of the City of San José, is within the State of California Seismic Hazard Zone for liquefaction.

Lateral Spreading is a type of ground failure that consists of the horizontal displacement of flat-lying alluvial material toward an open area, such as a steep bank of a creek channel. The northern portion of the study area is classified as having a high potential for lateral spreading. According to the State of California's Seismic Hazard Zone maps, most of the hillside areas along the western boundary of the CVSP Area may be susceptible to seismically-induced landsliding.

4.7.1.4 *Geologic Conditions within the Bailey-over-the-Hill Alignment Area*

Soils within the future Bailey-over-the-Hill roadway alignment area are predominantly colluvium and basin deposits. Bedrock is mapped as Franciscan Melange which includes serpentinite, chert, shale, blocky sandstone, and sheared rock material. Near the crest of the ridge, lenses of basaltic volcanic rock, serpentinite, and silica carbonate rock have been mapped. These are generally blockier, stronger rock types that are resistant to erosion and slope instability.

Cut slopes on the upside of the existing roadway typically have slope gradients of 1:1. Indications of raveling, rockfall, and localized shallow slumping were observed along most of the existing cut slopes. A recently active landslide was observed on the downslope eastern side of the existing roadway. The shoulder of the roadway is included in the landslide and concrete highway barriers have been placed along the edge of the road. The eastbound travel lane appears to have a high likelihood of experiencing downslope movement due to regression of the head scarp. No other failures of the roadway were observed.

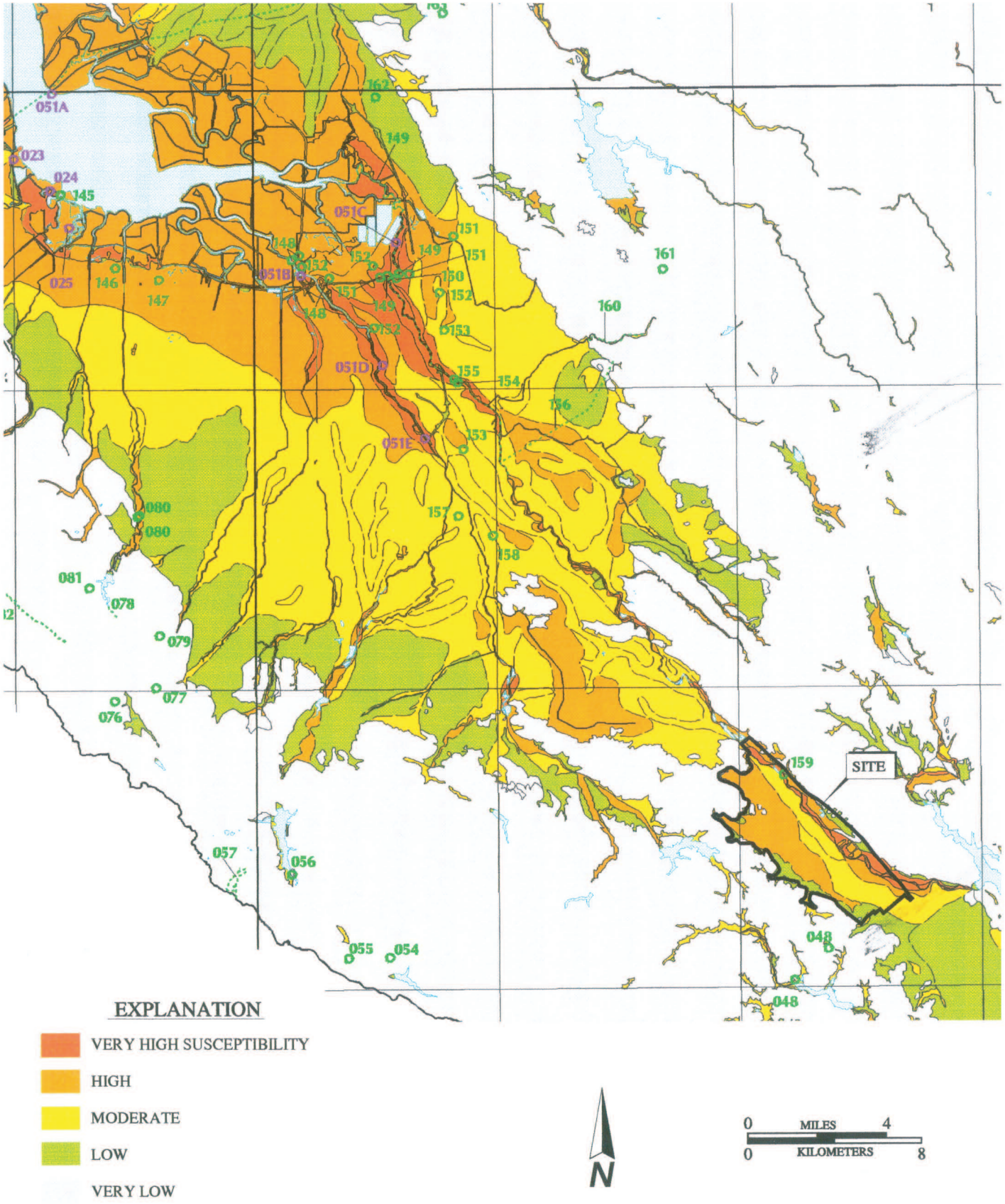
No earthquake faults are located within the BOH alignment area.

4.7.2 Geologic Impacts

4.7.2.1 *Thresholds of Significance*

For the purposes of this project, a geologic impact is considered significant if the project would:

- expose people or structures to substantial adverse effects including the risk of loss, injury or death involving rupture of a known earthquake fault, strong seismic ground shaking, seismic



Source: Engeo, Inc./Wentworth, Nicholson, Wright & Brown, 2000

LIQUEFACTION SUSCEPTIBILITY MAP FIGURE 4.7-3

- related ground failure (including liquefaction), landslides, or expansive soil; or
- expose people or property to major geologic or soils hazards that cannot be mitigated through the use of standard engineering design and seismic safety techniques; or
- cause substantial erosion or the loss of topsoil.

4.7.2.2 *Geologic Impacts from Development of the CVSP*

As described previously, the primary soil and geologic hazards identified within the CVSP Area are related to expansive soils, landsliding, liquefaction, and chrysotile asbestos. While creek bank erosion is also a potential hazard, no construction is proposed that would cause erosion along Coyote Creek. Similarly, the project proposes to relocate and restore Fisher Creek; therefore, the proposed project would not cause erosion along existing Fisher Creek. Construction along the future Fisher Creek would not occur within 100 feet of the creek banks; therefore, erosion would not occur as a result of urban development.

The soil and geologic hazards previously described could cause structural damage to future pavement, bridges, foundations, and/or structures; however, these conditions do not pose a significant geologic constraint to the urban development of the CVSP Development Area. This is because standard engineering requirements and practices that are embodied in the Uniform Building Code and enforced by the City of San José will ensure that future development is properly designed to take on-site soil conditions into account. Specific requirements will be developed by an engineering geologist, and will be reviewed and approved by the City, prior to the issuance of any grading or building permits. Therefore, development of the CVSP would not result in a significant geologic or soils impact.

Impact GEO-1: The soil conditions on the properties do not pose significant or unusual constraints to the development that would occur under the CVSP. Those properties of the various soils that could affect future urban development (e.g., expansiveness, potential for settlement, etc.) would be mitigated through the use of standard engineering practices. **[Less than Significant Impact]**

As previously described, serpentinite bedrock within the CVSP Area is the source for the basin and alluvial deposits within the project area. The chrysotile mineral can become airborne when the serpentine rock is crushed or pulverized. Chrysotile asbestos is only considered to be a health risk when it is in this airborne form. Grading and construction required for the implementation of the CVSP could result in the airborne release of naturally occurring asbestos fibers which would significantly impact construction workers and nearby residents. This impact is described in detail in Section 4.9, *Hazards and Hazardous Materials*, of this EIR.

4.7.2.3 *Seismic Impacts*

All of the properties that are the subject of this EIR are located within the seismically-active San Francisco Bay Area and severe ground shaking is probable during the anticipated life of the project. Upon implementation of the CVSP, future residents, as well as employees and patrons of the commercial and workplace uses, would be exposed to hazards associated with severe ground shaking during a major earthquake on one of the region's active faults. The hazard is not unique to the CVSP Development Area, because it applies to all locations throughout the greater Bay Area. The project will be designed and constructed in accordance with the Uniform Building Code guidelines for Seismic Zone 4 to avoid or minimize potential damage from seismic shaking on the sites. Potential

seismic impacts would be reduced to a less than significant level by the use of standard engineering techniques mandated by the Uniform Building Code.

Impact GEO-2: Development on any of the properties that are the subject of this EIR will be exposed to strong ground shaking during a large earthquake on one of the region's active faults. This impact is not unique to these sites, but applies to the entire region. Potential seismic hazards would be mitigated by the use of standard engineering techniques for Seismic Zone 4, as mandated by the Uniform Building Code. **[Less than Significant Impact]**

Shannon Fault

As previously described, the Shannon fault has been mapped as being present within the CVSP Development Area. Results of exploratory trenching within the study area found no indications of Holocene-aged faulting or seismic ground deformation, and lineaments previously mapped do not appear to be active. The potential for ground rupture is considered unlikely. Nevertheless, the City Engineering Geologist has determined that additional fault exploration in conjunction with geotechnical studies would be required on individual parcels within the City of San José Potential Fault Hazard and Potentially Active Fault Zones (Cooper-Clark, 1974), as shown on Figure 4.7-2, prior to development.

If the Shannon fault is located during pre-construction exploration and determined to be active, buildings constructed within, or immediately adjacent to the fault zone could sustain substantial damage due to such movement or rupture, which could in turn endanger the occupants of the buildings. It is possible that if a sufficient number of studies are produced with negative results (i.e., the fault is not located or if located, is determined to be inactive), the City Engineering Geologist may determine that no further exploration is required and development can proceed within the zone without additional fault studies.

Impact GEO-3: If the Shannon fault is located during pre-construction exploration and determined to be active, buildings constructed within, or immediately adjacent to the fault zone could sustain substantial damage due to such movement or rupture, which could in turn endanger the occupants of the buildings. **[Significant Impact]**

4.7.2.4 *Impacts within the Bailey-over-the-Hill Alignment Area*

It is anticipated that construction within the BOH alignment area would result in impacts associated with the construction of a roadway on hillsides that could exceed 2:1 slopes and be situated across landslide features. These types of roadways can be subject to downslope creep or instability unless proper grading techniques are used. The steeper the roadway slopes, the more likely that erosion and stability problems would be encountered, and subsequent extensive and frequent maintenance would be required, and as described in Appendix I. Depending upon the alternative alignment chosen and the slopes of the roadway, this could be a significant impact.

It should be noted that, depending upon the depth of planned cuts, difficult excavation conditions may be encountered during construction due to the types of bedrock found in the alignment area.

Impact GEO-4: The future construction of the BOH roadway could result in slope instability and erosion in the alignment area, and will be subject to the General Plan policies depending upon the roadway slopes ultimately proposed. **[Significant Impact]**

4.7.3 Mitigation and Avoidance Measures for Geologic Impacts

As previously described, the policies in the City of San José's 2020 General Plan have been adopted for the purpose of avoiding or mitigating environmental effects resulting from planned urban development within the City. Future CVSP development projects shall be subject to these General Plan policies, as well as the following standard measures to mitigate environmental impacts. Additional or modified mitigation measures may be identified based on subsequent environmental review, once specific development is proposed.

4.7.3.1 *Mitigation Measures for Geologic Impacts within the Development Area*

MM GEO-1.1 and 2.1: A detailed, design-level geotechnical investigation for the project shall be completed by all future applicants and shall be reviewed and approved by the City Engineering Geologist prior to Public Works clearance and issuance of development permits for any phase of the project. The geotechnical investigations shall identify and describe the specific engineering practices to be used to reduce or avoid potential geologic hazards on the site, including but not limited to remedial site grading and the incorporation of appropriate soil criteria in foundation design.

MM GEO-1.2 and 2.2: Project applicants shall implement the specific engineering practices that are identified in the geotechnical reports prepared for their specific sites. The geotechnical reports will be reviewed and approved by the City Engineering Geologist prior to final Public Works Department clearance from the City.

MM GEO-1.3 and 2.3: The extension of public utilities and infrastructure to serve the proposed development will be designed to withstand seismic and structural damage in conformance with the requirements of the California State Public Utilities Commission, consistent with Seismic Zone 4 criteria.

MM GEO-3.1: Prior to environmental clearance for a development permit within the City of San José Potential Fault Hazard Zone and Potentially Active Fault Zone (Cooper-Clark, 1974), additional fault exploration in conjunction with geotechnical studies shall be required. These studies shall be done in coordination with input from the City Engineering Geologist. Once a sufficient number of studies are produced with negative results, the City Engineering Geologist may determine that no further exploration is required because the fault cannot be located or is determined to be inactive, and development can proceed within the zone without further fault studies.

MM GEO-3.2: If an active fault zone is identified within the CVSP Development Area, a building exclusion zone shall be established within the City of San José

Potential Fault Hazard Zone and Potentially Active Fault Zone (Cooper-Clark, 1974) to the satisfaction of the City Geologist. The establishment of this zone will avoid impacts associated with potential movement/ground rupture if it is determined that an active fault is located within the Development Area. Development adjacent to the building exclusion zone would be required to include special design considerations as recommended in the site specific geotechnical reports.

4.7.3.2 *Mitigation Measures for BOH Geologic Impacts*

MM GEO-4.1: In general, cut fills along the proposed roadway should be not steeper than 2:1, unless geogrid-reinforced fill construction methods are used and the project is designed with a debris catchment bench located between the toe of all slopes and the roadway. Geotechnical buttress keyways would be constructed at the toes of the fill slopes, and drainage systems should be constructed in the keyways and within the planned fill areas. Other appropriate grading and construction techniques could also be used to reduce erosion and stability concerns.

MM GEO-4.2: Landslide materials would be removed and those areas would be filled with engineered fill materials using selective grading techniques and high compaction specifications.

4.7.4 Conclusions Regarding Geologic Impacts

Impact GEO-1: The soils that are present on the properties within the CVSP Development area, which are the subject of this EIR, do not pose significant or unusual constraints to the development that would occur under the CVSP. Those properties of the various soils that could affect future development (e.g., expansiveness, landslides, potential for settlement, etc.) would be mitigated through the use of standard engineering design practices as described in the site specific geotechnical reports to be prepared for each individual development (MM GEO-1.1 and 1.2). **[Less than Significant Impact]**

Impact GEO-2: Development proposed as part of the CVSP would be subjected to strong ground shaking during a large earthquake on one of the region's active faults. This impact is not unique to the Development Area, but applies to the entire region. Potential seismic impacts would be reduced to a less than significant level by the use of standard engineering techniques for Seismic Zone 4, as mandated by the Uniform Building Code (MM GEO 2.1 through 2.3). **[Less than Significant Impact]**

Impact GEO-3: Potential impacts to future development from movement or ground rupture along the Shannon Fault (if determined to be active) would be avoided by the creation of a building-exclusion zone as determined by the City Engineering Geologist, as described in above (MM GEO-3.1 and 3.2). **[Less than Significant Impact with Mitigation Incorporated]**

Impact GEO-4: The future construction of the Bailey-over-the-Hill roadway would result in significant geologic impacts depending upon the slope of the roadway and

location in proximity to mapped landslides. Therefore, the selection of an alignment and the ultimate design of this future roadway will be subject to the General Plan policies described in the introduction of this section of the EIR. In addition, the mitigation measures described above (GEO-4.1 and 4.2) would be considered at the time of development. **[Less than Significant Impact with Mitigation Incorporated]**